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Exhibit 2

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File Code: 3400, 3420 **Date:** 11/30/2015
Route To:

Subject: Forest Health Biological Evaluation – Walton Lake NEPA, Lookout Mountain RD, Ochoco NF

To: Slader Turner, District Ranger

Project Area:

The project area is located in the most popular campground on the Ochoco NF surrounding Walton Lake. The forest component of the vegetation, especially the very large old ponderosa pine and Douglas-fir, is a major part of the aesthetics of the lake. Thus, these trees have high societal value. Legacy ponderosa pines are also rare on the landscape and as such have ecological value. The developed site comprises four distinct ecological groups (plant associations) (Johnson and Clausnitzer, 1992), Table 1. These include: a) Grand Fir/queencup beadlily ((unit 2 and unit 3); b) Grand Fir/Columbia brome ((units 1, 4, and 5); c) Grand Fir/pinegrass (unit 6); 4) Riparian Shrublands and Meadows with scattered conifers (unit 7 and unit 8). Each of these groups has different carrying capacity, which affect threshold densities for bark beetle hazard as well as the risk and distribution of root disease (Table 1)

Summary of Important Insect and Disease Issues at Walton Lake

High bark beetle vulnerability in the ponderosa pine due to overstocking exists throughout much of the developed recreation area (Figure 1. Table 2 and 3). This heightened vulnerability to western pine beetle is especially concerning where large (dbh > 20-30 inches) and very large (dbh > 30 inch) legacy ponderosa pines are involved. Over 70% of unit 1 and unit 6 are at two to three times the recommended levels of stocking local guidelines (Johnson and Clausnitzer, 1992; Cochran et al. 1994). Based on current LIDAR data of the area, an estimated 91% of the large (20 – 30 in dbh) and largest (> 30 in dbh) ponderosa pines are currently growing under conditions of elevated density. This overstocking, combined with dwarf mistletoe [*Arceuthobium campylopodum*] infection, also has affected the ability of existing western larch to grow and of new larch to become established.

Laminated Root Rot (LRR) is widespread throughout units 2, 3, 4. These units are located along the access road south and south east of the lake, to the border of the

developed recreation site and beyond. Multi-layered stands of highly susceptible host trees (Douglas-fir and grand fir) make up the dominant forest cover, while resistant ponderosa pine and moderately susceptible larch are only minor components.

Where trees are within striking distance of the access road, weakened root structures and steadily progressing mortality from laminated root rot mortality threaten visitor safety. As laminated root rot continues to spread and intensify, host trees continue to deteriorate, die and often fall without warning, while still appearing live and healthy (Filip and Goheen 1982). Every year dead trees and others with structural defects due to root disease are cut to mitigate hazards along this heavily-used road. An intensive inventory of the entire units 1, 2, 3, 4, and 5 (conducted in July 2015) indicates that LRR is distributed, at some level, throughout units 2, 3 and 4. These three units are moist sites that are dominated by highly susceptible host species and LRR continues to increase in severity as evidenced by numerous dying and newly dead host trees. The disease has also spread across the road and into the southernmost areas of unit 1 and SW edge of unit 5, where there are highly susceptible hosts. However, it is unlikely that LRR will spread much farther into these units since the highly susceptible hosts/moist site combination does not occur elsewhere in these blocks.

<u>Background Information for these Insect and Disease Agents</u>

Western Pine Beetle Overview

Western Pine beetle (*Dendroctonus brevicomis)* is a bark beetle that can aggressively attack and kill larger ponderosa pine. Vulnerability to this attack is known to increase when host trees are stressed. Most of the time the populations of these native insects are at low levels and the beetles attack stressed, damaged, or weakened ponderosa pines. Trees damaged mechanically or by lightning or fire are often targets of attack, as are diseased host trees. Western pine beetle populations often increase dramatically during periods of drought.

Overstocking is a common cause of stress in ponderosa pine. Often this stress can be alleviated by thinning. The amount of trees/vegetation that a site can support (carrying capacity) and thus, the amount of thinning required depends on the quality of the site and the type of tree or vegetation. Guidelines to determine the carrying capacity of the site have most recently been summarized by Powell 1999 and Cochran et al 1994. These serve to guide thinning treatments with respect to alleviating western pine beetle attack. Since trees grow over time, target density

levels are usually well below carrying capacity in order to sustain the lowered vulnerability over a reasonable amount of time, thus minimizing the need for frequent entries.

Laminated Root Rot Overview

Laminated root rot (LRR) is caused by the fungus *Phellinus sulphurascens (*formerly *Phellinus weirii).* It is the most damaging root disease of forest trees in Oregon and Washington and one of the most hazardous to people and property in developed sites (Filip et al, 2014). On the Ochoco NF, however, this disease is generally restricted to moist mixed conifer sites on north facing slopes (which is why it occurs in units 2, 3, 4, and the perimeter 5). Highly susceptible hosts are true firs, Douglas-fir and mountain hemlock. These tree species are readily infected and their roots are extensively decayed by the pathogen. Western larch has traditionally been considered a species that is intermediately susceptible to *P. sulphurascens (*Hadfield et al 1986). While a high proportion of the larch growing at the advancing margins of active centers can become infected, larch rarely exhibit the rapid decay and death of numerous roots characteristic of highly susceptible hosts (Filip and Schmitt, 1979). There is some evidence to indicate that stress (induced by dwarf mistletoe infection or overcrowding can increase susceptibility of larch to successful attack by *P. sulphurascens* (Hoffman, 2004, Bloomberg and Reynolds 1985). Pines and cedars are rarely infected and almost never killed by *P. sulphurascens* even though some root colonization can occur and the pathogen may maintain itself on the site. Hardwoods are immune. If conifers remain on the site (even resistant ones*)* the fungus can persist from tree generation to generation. Therefore LRR should be considered as essentially a disease of the site.

P. sulphurascens spreads little, if at all, by windblown spores so establishment of new infection centers are rare. Nor does it grow through the soil. Instead, *P. sulphurascens* spreads from tree to tree when an infected root (living or dead) with external mycelia (greyish buff fungal material called "ectotrophic mycelium") contacts **a living host root**. Once this contact occurs, the fungus penetrates the root through intact bark, killing phloem and cambium as it enters and initiates decay in the xylem (Wallis and Reynolds 1965). Both lignin and cellulose are utilized. Infected trees may then live in a slowly declining state for many years, gaining necessary water and nutrients from adventitious roots formed near the root collar (Bloomberg and Reynolds, 1985; Thies, 1983). Trees eventually die, often as a result of weakened supporting roots. Infected trees commonly fail when live and many may be asymptomatic, and their crowns appear healthy until that time. Once the tree dies the fungus continues to survive (but not grow) in infected stumps and roots that remain in the soil; up to at least 50 years if these are very large (Childs 1963; Hansen 1979). The amount of area with surface mycelia (which is required for spread), however, progressively shrinks until all that remains (after 50 years) are small patches on a small portion of the roots (Hansen, 1979).

As long as there are highly susceptible hosts present, LRR centers will continue to

expand. On average, mortality due to LRR advances about 1 ft/ year (McCauley and Cook 1980), but the advance is usually uneven, reflecting the irregular distribution of trees in the forest and the sporadic nature of winds and bark beetles that topple or kill the root-rotted trees.

Unlike other important root diseases (e.g. Armillaria root disease (*Armillaria ostoyae*) and Heterobasidion root disease (*Heterobasidion occidentale* and *H. irregulare*)), susceptibility to and mortality from LRR does not seem to be affected by tree vigor (Hansen, 1986), with the possible exception of western larch. Additionally, there is no published evidence to indicate that laminated root rot is influenced by topography, climate, or soil conditions in eastern Oregon and Washington. Instead, distribution of LRR appears to be correlated with environmental conditions and historical disturbances that favor continuous site occupancy by susceptible conifers. *P. sulphurascens* occurs and causes severe damage on a variety of site types and appears to be well adapted to the same environmental conditions that favor susceptible hosts. On the Ochoco NF these sites commonly occur on north facing slopes with Grand Fir / queencup beadlily, Grand Fir / twinflower, and Grand Fir / Columbia brome plant associations.

Possible human effects on abundance of laminated root rot. Harvest of economically valuable species such as ponderosa pine and western larch and fire exclusion have had the greatest ecological impact in mixed conifer and pine forests east of the Cascade Mountains where *Armillaria ostoyae* and *Heterobasidion spp.* join *P. sulphurascens* in shaping the forest landscape (Hansen and Goheen 2000). The species composition of these forests has been dramatically shifted from early seral pines and western larch to mid- and late-seral Douglas-fir and *Abies* species. Since the latter tree species are generally more susceptible to all three root pathogens, the result has been a general increase in root rot incidence and impact.

Long-term impact of laminated root rot. The amount of LRR maintained on a site over time depends on the amount and continuity of highly susceptible hosts. In some unmanaged older stands, inoculum is probably kept at a relatively low density by natural processes. Wind-throw of infected trees and then, colonization of openings by hardwoods or non-susceptible species are examples of where LRR is limited by the combination of an array of species on the site and the disturbance regime (mostly on the westside of the Cascades).

However, where susceptible species are a natural part of the stand and hardwood and shrub species do not readily regenerate (as is the case in block 1) LRR openings will be continually regenerated by susceptible species and little change is likely to occur in inoculum density from one generation to the next. In these places, LRR centers are not likely to "die out" on their own making the likelihood of a LRR facilitated return to an early seral forest unlikely (Thies and Sturrock 1995).

Absent of fire or management, stand structure and density and fuel loading will likely change however. Small LRR mortality centers ultimately coalesce into larger ones;

fuel loading will build as mortality continues. Fewer and fewer susceptible old individuals remain to infect on the perimeters, and scattered mortality continues, as will regeneration of susceptible and tolerant trees within the area of infection. In other words, the "root disease climax" community is usually more open, with fewer and more scattered large trees (Van Der Kamp, 1991) and ever higher fuel loading. Because of the continuously high inoculum intensity, even the tolerant trees are inherently smaller and shorter-lived than the susceptible trees they replaced.

Managing laminated root rot in developed recreation sites. Given the history of damaging failure due to laminated root rot in recreation sites in the Pacific Northwest, the often unpredictable nature of the tree failures, the difficulty identifying the level of root damage on individual trees, and determining the actual extent of affected areas, laminated root rot should be of particular concern to managers of infested sites (Filip et al 2014).

Managing laminated root rot starts by mapping where it occurs, the severity of the infection, where it might occur and where it does not occur. Root diseases are seldom uniformly distributed throughout affected stands. For this reason, root disease surveys should be designed to sample all portions of stands to maximize the probability of detecting most or all of the disease centers.

This is done by first determining the boundaries of root disease centers by using crown symptoms and root excavations to identify signs of the disease. The margin of the boundary should be buffered to include susceptible host trees growing ≤ 2 trees beyond (or a distance of >50 feet) the last tree with confirmed root disease since many of these trees will be infected and could have compromised root systems (Thies and Sturrock 1995).

Within this general boundary, there are a number of options to map or estimate root disease distribution or impact. Which technique, or combination of techniques, is chosen depends on the specific questions the manager wants the survey to address as well as the needed detail in the spatial maps, impact estimations, and the desired use of predictive models such as Forest Vegetation Simulator. Root diseases are seldom uniformly distributed throughout affected stands, for this reason, systematic surveys should be designed to sample all parts of the stand/area of interest. As a result, surveys are usually done on a grid. Grid patterns of 2 x 3 chains (1 chain = 66 ft) are used commonly where it is important to have very accurate determinations of root disease locations. Patterns of 5 x 5 and 10 x 10 chains are used where time available for survey is limited or it is not as important to have highly accurate delineations of disease centers (Hadfield et al, 1986). Some (but by no means all) of these methods include: 1) A complete stem map of the infected/and suspected trees

throughout the area. This can be especially useful for scientific studies and host susceptibility comparisons; 2) The line-intercept survey method (Hadfield et al 1986). This method is useful for determining areas where root disease has already caused visible impact and can be used to roughly estimate distribution and/or areas where timber volume has already been impacted; 3) Variable radius plots established throughout the area on a grid (Hadfield et al 1986). This method is highly useful if the manager wants to use the Western Root Disease Model (WRDM) in Forest Vegetation Simulator (FVS) (to estimate future impact); 4) Survey area gridded out and then each cell in the grid assigned some measure of root disease severity. The Root Disease Severity Rating (RDSR) (Hagle 1992, See Key to Figure 3) is commonly used because it combines a measure of distribution and severity. This system can be applied using aerial photo-interpretation and/or field sampling. If positive confirmation is required, a field sample is preferred. If a more precise measure is desired, a buffer as described above should be added to the line length. Following surveys, management options can then be strategically planned spatially based on the extent and severity of root disease.

Once the extent and severity of the root disease has been established a treatment can be devised. Some of these include:

No treatment. Left untreated, the root disease will continue to inexorably spread throughout the highly susceptible hosts reducing forest cover, and contributing to increased fuel loading. If this situation is occurring in a developed site, the root disease creates a long term yearly source of hazardous trees.

Stop the spread with a buffer. Sometimes it is possible to stop the further spread of laminated by cutting a buffer and planting it with less susceptible host trees. Laminated root rot does not spread into dead root material. Therefore, if there is a clear demarcation between infested and non-infested portions of the stand, cutting a 50 foot wide buffer can stop spread into new areas with host trees and thus eliminate these trees as a source of future hazard trees at least from LRR (Shaw et al 2009). This situation is very rare in the forests east of the Cascades. More commonly, laminated root rot mortality is widely distributed across the site although areas of moderate- and severe mortality tend to be in a patchy distribution. This "diffused" distribution makes buffering LRR impractical since there are often no contiguous non-infested areas that are large enough to isolate and protect with a buffer.

Regeneration harvest and planting with more resistant species is another approach. This technique should halt the steady creation of hazard trees over time and the maintenance associated with it. Away from roads, campgrounds and other

developed high-use areas, the option exists to leave some of the root disease center untreated. This approach could afford the opportunity to introduce early seral species that are often under-represented (compared to what occurred historically) in the moist mixed conifer plant associations due to fire exclusion.

Description of Management Units and Proposed Treatments

Existing forest structure and density was mapped using LiDAR. Techniques for identifying individual trees using LiDAR were based on (Popescu and Wynne 2004, Falkowski et al 2006, Li et al 2012). DBH and basal area (BA) were derived from LiDAR (by Michael Simpson, Ecologist FHP USFS) by developing regression equations relating the height of individual trees to DBH using Forest Inventory Data. Dead trees were also mapped from LiDAR using technique's developed by Wing et al 2015. Fusion software (McGaughey 2009) was used for display.

Unit 2, 3, 4, the edges of unit 5and a small inclusion of unit 1 (40 acres). These units occur in moist mixed conifer forest, the most productive of the vegetation types in the Walton Lake Restoration Project area. The south access road is dominated by scattered overstory Douglas-fir, mistletoe-infected larch (50 large or very large), groups of ponderosa pine (147 large or very large) and white fir ingrowth.

An intensive systematic ground inventory of the area indicates that LRR is present at varying levels throughout Our field survey was a 2 step process. First, we determined the outer extent of the area in block 1 infested with root disease by walking 66 feet (a chain) outward from the last confirmed LRR area and visually scanning for more LRR signs and symptoms. If an area distal to the last infested location was confirmed, then the process was repeated. LRR was confirmed based on the visible signs of the pathogen; either as ectrophic mycelia in bark of roots or as setal hyphae in decayed wood of dead trees. From this field mapping of the exterior boundaries of the disease center, it was determined to encompass most of block 1 as well as a large area exterior to the boundaries of the developed site (figure 2a). The root disease pattern within the infection boundary was observed to be very diffuse (severe in some places, less so in others). This is a very typical root disease pattern in central Oregon cool mixed conifer forests.

We then mapped the area internal to the root disease boundary using a field transect method (as recommended by Hadfield et al, 1986) which assigns each acre a "Root Disease Severity Rating" (RDSR) (Hagle, 1992) . The RDSR is commonly used to simultaneously describe the occurrence and severity of root disease (Figure 2b). In

areas where laminated root rot was not obvious, we then looked for either signs of the fungus itself on dead trees or measured the distance from a dead or symptomatic trees. If an asymptomatic (apparently healthy) but susceptible tree was within 30 feet of confirmed laminated, we classified it as "likely infected". Assuming infection based on distance is a standard procedure for mapping laminated root rot. Highly susceptible host trees within 30 feet of trees or stumps colonized by *Phellinus sulphurascens* are assumed to have a high probability of being infected. Conversely, those growing 50 ft. or more away from the nearest LRR killed tree are assumed to have a very high probability of being completely infection-free (Harvey and Hessburg 1992, Thies and Sturrock 1995).

Containing the laminated root rot within a buffer is not possible in blocks 2, 3 and 4, since it is already ubiquitous throughout the moist mixed conifer setting. A buffer is unnecessary in Blocks 1 and 5since it is highly unlikely that it will spread into the dry mixed conifer-, or the ponderosa pine plant association groups (which comprise the remainder of these units) to any significant degree.

Thinning will not slow the progress of laminated root rot through the host type. There are not enough non-hosts present to retain forested character if hosts are removed. We therefore recommend a treatment that will remove the highly susceptible host and establish a more sustainable and diverse species mix dominated by early seral species that are more resistant to LRR and characteristic to moist mixed conifer. Specifically, we recommend:

1) Remove all highly susceptible hosts within 100- to 150 (if these trees are 150+ tall) of the access road and trail in order to prevent the continuous hazard tree problem at present and over the next several decades at least.

2) A mixture of highly resistant ponderosa pine, western white pine, and immune hardwoods and shrubs could planted immediately adjacent to the road (50 ft.). Openings could also be left to encourage herbaceous vegetation.

3) Further away from the road, we recommend that groups of western larch be added to the planting mix. These should not be planted, however, within 35 feet of dwarf mistletoe infected and should be sited within the existing LRR openings to minimize the amount of LRR inoculum exposure (the amount of inoculum is assumed to be lower in these openings because there are no live infected trees).

Leave groups of hosts (and root disease) 150 feet or more from the road and trail

will be left. These will continue to deteriorate but will also provide habitat (e.g., snag retention) for late seral species, visual screening and structural diversity in the short-term. We suggest these leave groups be placed in areas where there is very light to moderate LRR impact at present in order to maximize the number of larger green tree replacements over time as well as provide better visual screening. We also recommend the leave areas are not placed where there are large ponderosa pine or larch.

Unit 1 (28 acres). Exterior to the north and west of the access road (but still in the developed site) the forest is mixed conifer with a significant component of large and very large ponderosa pine and Douglas-fir. Based on LIDAR data, we estimate that there are 1,151 large or very large trees in block 1. The majority of very large trees are ponderosa pine but also a significant portion of them are Douglas-fir. Because the area is overstocked with respect to pine, there is elevated vulnerability to western and/or mountain pine beetle. We recommend thinning the stands from below (aka removing the smaller trees) to ft^2/acre of basal area that is 20% below the upper management zone. For trees less than 21 inches in diameter, favor white fir/grand fir for removal. We further recommend leaving all large pine and Douglas-fir. Removal of true fir will achieve most of the density reduction needed. In some cases larger true fir will have to be removed to achieve densities that favor the legacy pines when they are growing close to large pines, Douglas-fir or larch. Thinning will ameliorate density induced bark beetle vulnerability for the next several decades. We recognize that the treatment will be designed to incorporate screening and shading as appropriate near recreation areas).

Unit 5, 6 (69 acres). This area is on the north shore of the lake and is mostly exterior to the campground proper. The forest is essentially pure ponderosa pine of multiple sizes but includes a number of very large pines (dbh 30+ in). Much of this block is well above carrying capacity (100 ft^2/acre of basal area) with the exception of the trees right next to the shore (Figure 1, Table 1). We recommend thinning the smaller trees to reduce stocking and lower the risk of larger overstory trees being attacked by western pine beetle. Removing trees in the understory will also reduce fuels surrounding large pines and reduce the likelihood of large pines being killed in the event of a fire.

Unit 7 (32 acres). The forest within the campground proper is characterized by large ponderosa pines, western larch and riparian shrubs (in some areas) immediately surrounding the lake. Minor portions of this area are overstocked (Figure 1). Most of the pine trees are healthy. A light thinning from below in these overstocked groups or no thinning at all is recommended. Reduced tree densities

surrounding large pines will lower the risk of larger overstory trees being killed by bark beetles and reduce the risk of larger overstory trees being killed in the event of a fire.

Summary

Proactive management at Walton Lake is important to protect the longevity of the large ponderosa pine and long term visitor safety. Properly designed and implemented, a combination of no treatment, thinning from below, sanitation removals and planting can significantly mitigate the undesirable effects of both western pine beetle and laminated root rot while at the same time introducing elements of biodiversity.

If you have any further questions or comments with respect to this evaluation please do not hesitate to contact our Service Center.

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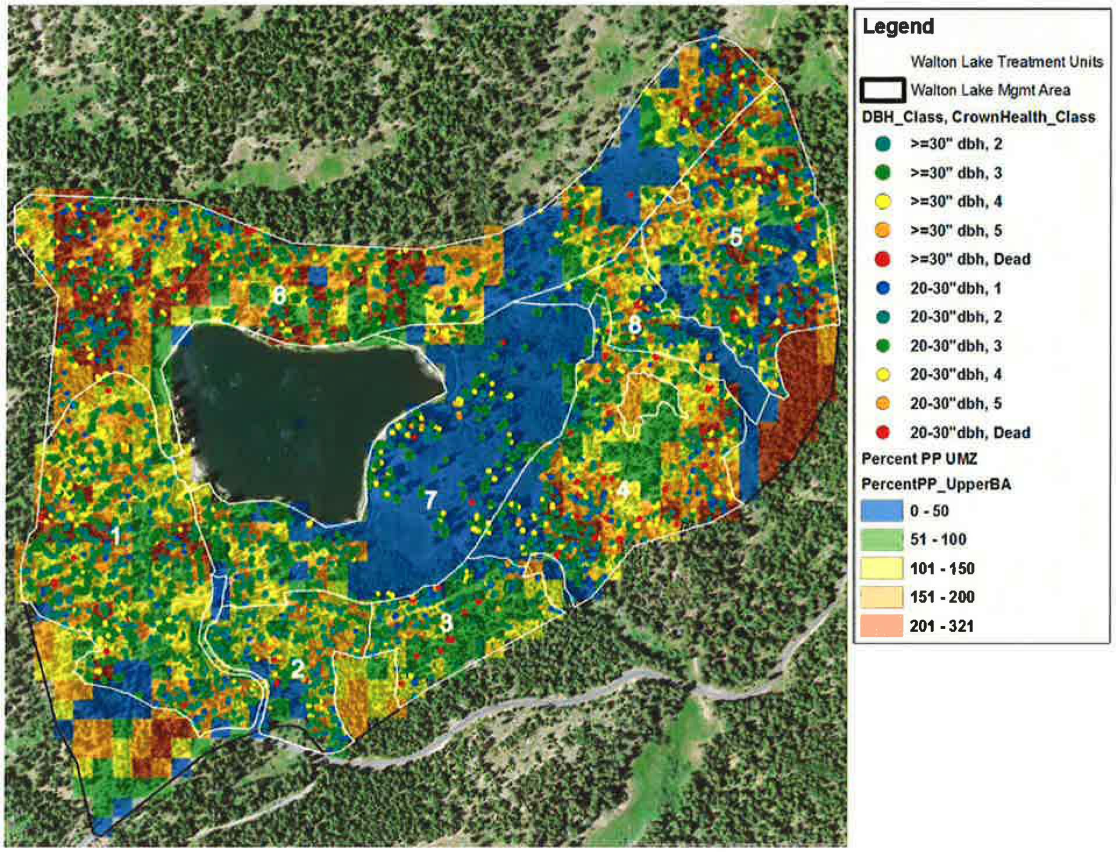


Figure 1. Map of stocking relative to carrying capacity at a 30 m pixel resolution and individual large trees using recent LIDAR data. Most large trees in units 1, 6, and the north half of unit 5 are ponderosa pine or Douglas-fir.. *Green areas in units 2, 3, and 4 are root disease openings.*

Table 1. Walton Lake treatment blocks and target thinning range to lower hazard to pine bark beetles (primarily Western Pine Beetle)

Plant Assoc. Abgr/Clun	Unit 2 and 3		Plant Assoc. Abgr/Brvu	Unit 1, 4, and 5		Plant Assoc. Abgr/Caru	Unit 6	
Species	Upper Mgmt BA/Acre	Lower Mgmt BA/Acre	Species	Upper Mgmt BA/Acre	Lower Mgmt BA/Acre	Species	Upper Mgmt BA/Acre	Lower Mgmt BA/Acre
Abgr	200	123	Abgr	169	104	Abgr	129	79
Laoc	161	99	Laoc	109	67	Laoc	86	53
Psme	161	99	Psme	115	71	Psme	116	71
Pien	183	113	Pien	168	103	Pico	92	57
Pipo	176	108	Pipo	124	78	Pico	85	52

Table 2. Number of large trees per acre by unit and density class with reference to Ponderosa Pine upper management zone.

Treatment Unit	Acres	TPA Large Trees (>=20" dbh)				
		TPA Dead	TPA Live	<=100% PP UMZ	100-150% PP UMZ	>150% PP UMZ
Unit #1	28	0.4	30.4	3.3	11.6	15.5
Unit #2	9	0.4	28.2	5.3	14.4	8.4
Unit #3	9	1.1	15.6	4.4	8.7	2.4
Unit #4	23	1.5	18.7	2.2	3.7	12.9
Unit #5	20	0.2	27.5	3.1	4.6	19.8
Unit #6	49	0.3	18.5	1.1	3.2	14.3
Unit #7	32	0.1	6.3	1.6	2.0	2.8
Unit #8	7	0.7	25.3	2.9	9.7	12.7

Table 3. Total number of large trees by unit and density class with reference to Ponderosa Pine upper management zone.

Treatment Unit	Acres	Total Large Trees (>=20" dbh)				
		Dead Trees	Total Live	<=100% PP UMZ	100-150% PP UMZ	>150% PP UMZ
Unit #1	28	11	851	92	324	435
Unit #2	9	4	254	48	130	76
Unit #3	9	10	140	40	78	22
Unit #4	23	35	431	50	85	296
Unit #5	20	4	549	62	91	396
Unit #6	49	13	908	53	155	700
Unit #7	32	3	202	51	63	88
Unit #8	7	5	177	20	68	89

Table 4. Percent of total large trees by unit and density class with reference to Ponderosa Pine upper management zone.

Treatment Unit	Acres	% Large Trees (>=20" dbh) by % PP UMZ				
		% Dead	% Live	<=100% PP UMZ	100-150% PP UMZ	>150% PP UMZ
Unit #1	28	1.3%	98.7%	11%	38%	51%
Unit #2	9	1.6%	98.4%	19%	51%	30%
Unit #3	9	6.7%	93.3%	29%	56%	16%
Unit #4	23	7.5%	92.5%	12%	20%	69%
Unit #5	20	0.7%	99.3%	11%	17%	72%
Unit #6	49	1.4%	98.6%	6%	17%	77%
Unit #7	32	1.5%	98.5%	25%	31%	44%
Unit #8	7	2.7%	97.3%	11%	38%	50%

Figure 2a. Extent of Laminated Root Disease in Walton Lake Project Area.

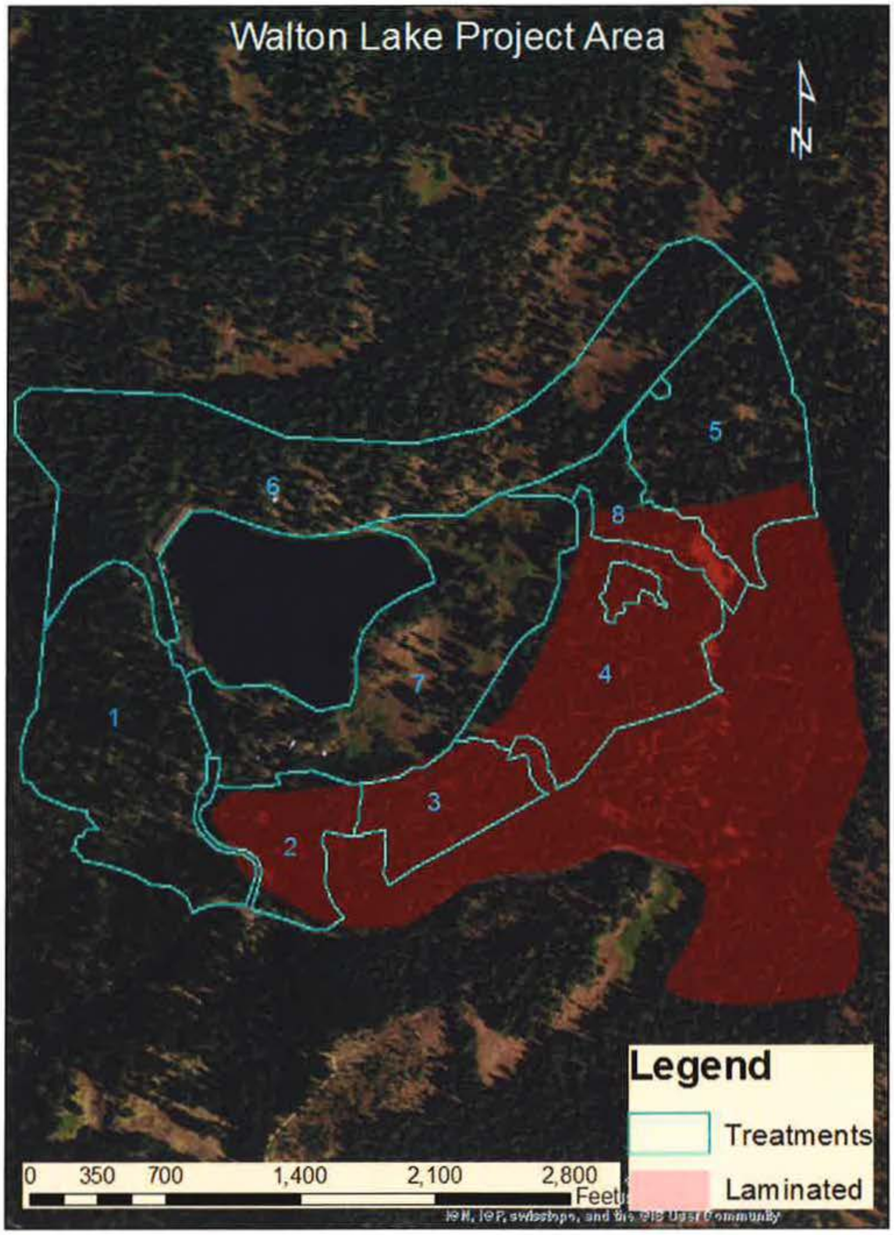
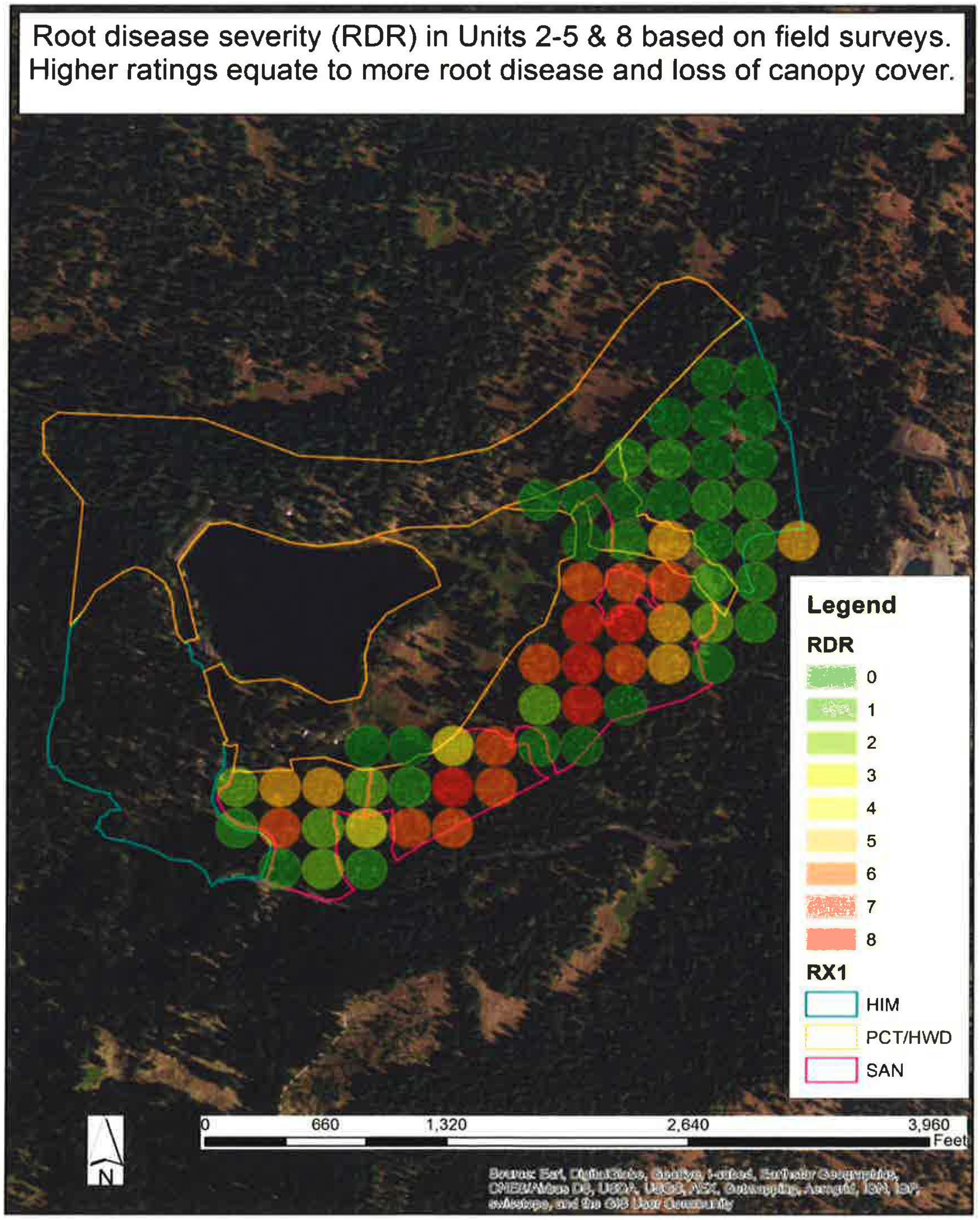


Figure 2b. Root disease severity rating (RDSR) based on field surveys. Higher RDSR equate to more root disease and loss of canopy cover.



Key to Figure 2b Root Disease Severity Rating Classes (Hagle, 1992)

Rating	Condition
9	Plot is entirely within a a definite root disease center; no overstory trees of susceptible species present.
8	The entire inventory unit falls within a definite root disease pocket with only one or very few susceptible overstory trees presents
7	At least 75 percent canopy reduction. Sampling units reaching this severity level are usually occupied by only the most susceptible species. There are a very few of the original overstory trees remaining although infested ground is often densely stocked with regeneration of susceptible species.
6	Between 50-75 percent reduction in canopy with most of the ground area considered infected as evidenced by symptomatic trees much of the canopy variation in the category is generally a result of root disease tolerant species occupying infested ground
5	Canopy reduction of 30-50- percent as a result of root disease. At least half of the ground area of the macro plot/pixel considered infested with evidence of root disease-killed trees. Macro plots representing mature stands with half of their volume in root disease-tolerant species usually do not go much above severity "5" because of the ameliorating effect of the disease tolerant trees.
4	Canopy reduction at least 20-percent; up to 30-percent; usually as a result of root disease mortality. Snags and downed trees removed from canopy by disease as well as lie trees with advanced symptom contribute to impact.
3	Canopy reduction evident, up to 20-percent; usually as a result of death of one codominant tree on and otherwise fully stocked site. In absence of mortality, numerous trees showing symptoms of root disease infection.
2	Minor evidence of root disease such as suppressed trees killed by root disease or a minor part of the overstory showing symptoms of infection. Little or no detectable reduction in canopy closure or volume
1	Stocking appears normal but there is evidence of root disease within 50 feet of the plot/pixel
0	No apparent root disease within 50 feet of the plot.